Carnevale Subdivision

CEQA PRELIMINARY DRAINAGE STUDY

Prepared for

THE COUNTY OF SAN DIEGO

TPM 21133

Environmental Log No. 08-14-015

August 24, 2010
Prepared by David Evans and Associates, Inc.
110 West A Street, Suite 1700
San Diego, CA 92101
(619) 400 0600

DAVID EVANS AND ASSOCIATES INC

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DEPARTMENT OF PLANNING AND LAND USE

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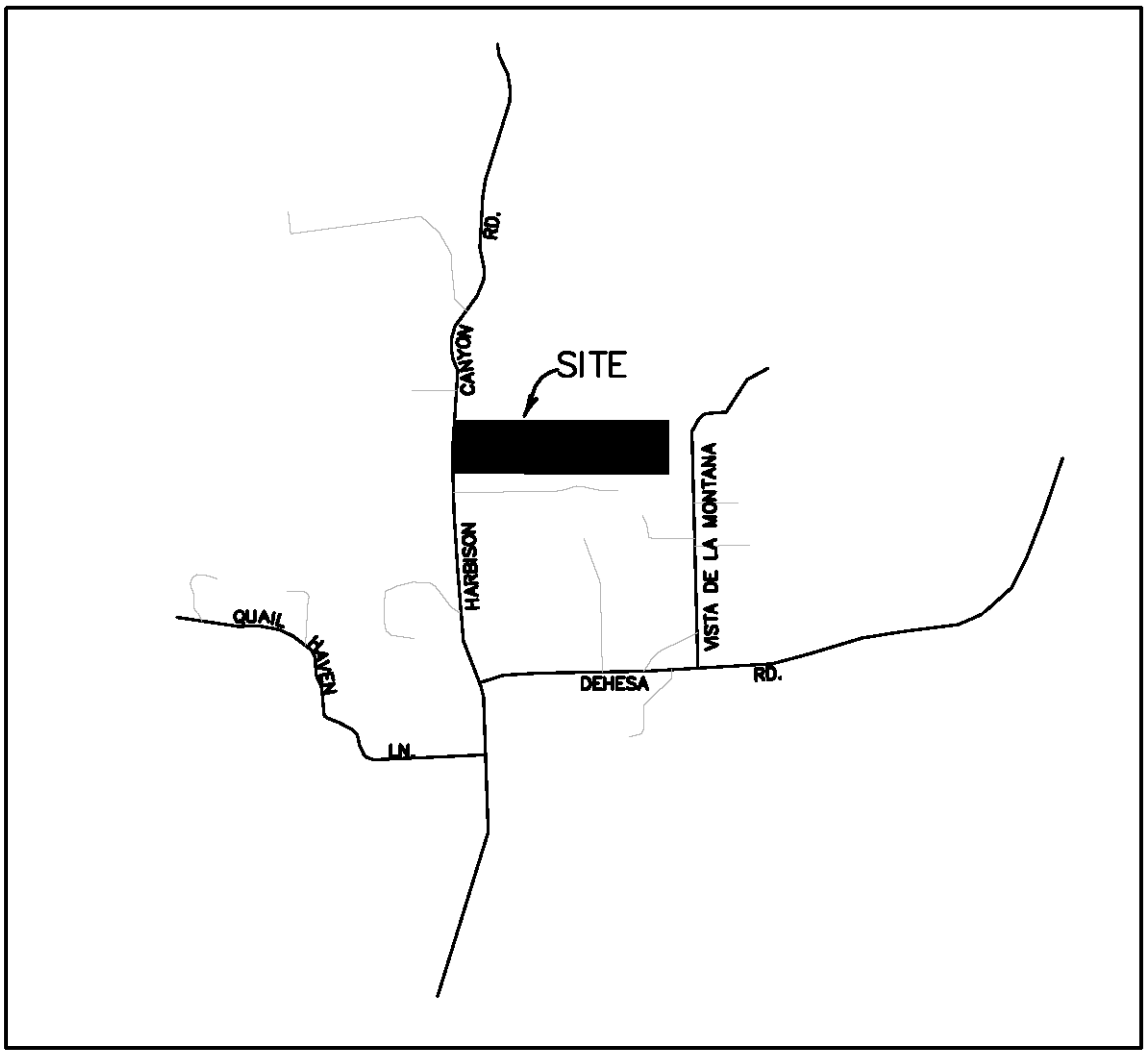


VICINITY MAP

NO SCALE

Introduction

The site is 12.4 acres in size and is located on the east side of Harbison Canyon Road approximately one and one-half miles north of the confluence of Harbison Canyon Creek and Sweetwater River. Harbison Canyon Creek flows through the westerly portion of the project site. The project will subdivide the property into 4 new parcels and one remainder parcel. The remainder parcel is currently developed with one single family home located between the Harbison Canyon Road and the creek. The existing creek floodplain will be completely contained within the remainder parcel with no proposed improvements. The new parcels will be located on the hillside to the east above the existing flood plain. Runoff from the new developed area generally drains westerly toward the creek.

Purpose and Scope

The proposed project will subdivide an underdeveloped parcel to provide four additional parcels. The minimum lot size is 2 acres. The total area of impervious surfaces will increase as a result of development however the increase is minimal compared to the total project area. The purpose of this study is to quantify the peak rate of runoff for both the existing and developed conditions. The total volume of runoff will increase slightly as a result of the development. This study will also define improvements that will mitigate the impacts related to the development.

The existing parcel is 12.4 acres. The area to be impacted as a result of the development will be limited to approximately 4 acres. The developed project area is less than 50 acres therefore the project is not subject to the hydromodification regulations per San Diego County's Interim Hydromodification Criteria. The project has incorporated Low Impact design elements to limit the

effects of increased impervious areas. These elements are evaluated on a qualitative basis as opposed to a quantitative basis.

Drainage from the project site is tributary to Harbison Canyon Creek. The project site is very small compared to the overall drainage basin tributary to the creek; therefore the total increase in the volume of runoff to the creek is minimal. The study will address the qualitative impacts to the creek, but will not address quantitative impacts.

Existing Conditions

The project site is located on the hillside east of Harbison Canyon Road, north of the intersection of Dehesa Road. Development currently exists only on the remainder site. There are dirt roads in the area that provide access to the middle and eastern portions of the property. The majority of the runoff flows from the northeastern corner of the property to the existing road. It concentrates in the graded swale on the south side of the road, and then flows westerly. Concentrated flows outlet to the existing riding rink and continue to the creek. The area is likely subject to erosion, which would cause increased sediment and siltation deposits in the creek. A small amount of runoff in the northerly portion of the sub-basin sheet flows directly to the creek.

Proposed Conditions

Runoff from the newly developed building pad areas will be filtered and intercepted by a roadside ditch to avoid contamination from the proposed roadway. The ditch will be lined with natural cobble to increase the roughness and slow the travel time to less than the pre-existing condition. The project has been designed to only use underground storm drains where runoff has been redirected across new driveways and on lot 4 where the existing runoff pattern is in close proximity to the leach field area. The majority of the basin runoff will be collected at the west end of the roadway and will be directed northerly to avoid the existing equestrian riding rink. Runoff will be outlet to the flatter areas using a 10' wide energy dissipater to return flows to a sheet pattern with lower velocities.

Runoff from the new paved roadway will concentrate at the westerly end of the road. Runoff will be outlet to a bio-swale that will divert the runoff to the south of the equestrian riding rink. It will also decrease the velocity of the runoff and allow for excess water to infiltrate into the ground, in turn decreasing the volume of runoff. The minimal flow from the road will be outlet to the creek as sheet flow.

In addition to the swale and cobble-lined ditch, vegetated strips will be planted along the driveways. The driveways will be cross-sloped to drain to the strips. Like the swale, the strips will slow down the velocity and filter runoff.

Methodology and Calculations

The hydrology calculations were prepared in accordance with the County of San Diego Drainage Design Manual dated June 2003. Base maps were prepared to define the basin areas using a combination of the County of San Diego 200 scale topography maps and the project topography maps and tentative map grading design.

Flow rates were calculated using the rational method, Q=CIA, with 'C' being the runoff coefficient, 'I' being the intensity, and 'A' being the drainage area in acres. Weighted 'C' values are calculated for basins containing both developed and undeveloped land. The 'C' values are based on Soil Type "B". The intensities are calculated based on the County of San Diego Hydrology Manual where $I = 7.44\ P_6 D^{-0.645}$, P_6 is the 6 hour precipitation in inches and D is the Time of Concentration of the storm in minutes.

Conclusions & Recommendations

The total volume of existing runoff from Basin A outlets into Harbison Canyon Creek (see basin maps in the appendix). The tributary area of the basin is 17.7 acres. Basin A currently sheet flows from the northeastern corner of the property to the existing dirt road, then through the southern portion of the remainder lot ending in Harbison Canyon Creek with a Q_{100} of 30.2 cfs.

For the proposed conditions, runoff from Basin A will follow the natural drainage pattern until it is intercepted by a concrete ditch in the northeastern portion of lot 4 and redirected towards the end of the cul-de-sac between the driveways on lots 3 and 4. Runoff will go through a system that includes both a cobble-lined ditch and underground storm drains at the driveway locations. The lined ditch helps to increase the time of concentration from 5.9 minutes to 6.6 minutes. The

increased Tc offsets the increased weighted C factor, therefore the 100 year flow after development is essentially the same as pre-development. The following table summarizes the pre developed and post developed conditions for various storm events.

Peak Rate of Runoff at Point of Concentration			
Six Hour Storm Event	**Existing Condition CFS**	**Proposed without Detention CFS**	**Percentage Change**
Q 100	30.2	30.0	-0.07%
Q 10	19.8	19.7	-0.05%
Q 5	17.7	17.6	-0.06%
Q 2	13.6	13.4	-0.1%

In the existing condition, runoff concentrates at the westerly end of the graded road and flows through the existing riding rink before flowing into the creek. This concentrated flow through the rink likely results in erosion of the rink area and silts and pollutants from the riding rink being conveyed to the creek. The proposed design redirects flows from the basin around the rink to avoid the erosion and minimize the pollutant discharge. A much smaller roadway area is directed to the creek via a bio-swale. The bio-swale filters the road runoff and directs the runoff to the south of the riding rink. The larger part of the basin is directed northerly to a wide energy dissipater designed to mitigate the affects of concentration and provides a sheet flow condition to the creek. Runoff velocities to the creek and the erosion potential at the point of concentration within the project site will be improved as a result of the development.

There will be a slight increase in the total volume of runoff from the site as a result of the increase in impervious surfaces. Increases in runoff velocity and volume may increase the

potential for erosion downstream of the project. Stream bank and riverbed erosion are possible due to the increase in runoff and sediment deposits, which could result in encroachment on the neighboring habitat. Stream bank erosion could also result in flooding downstream during a 100-year storm event. The newly developed area within the project is limited to approximately 9 acres. The drainage basin tributary to the Harbison Canyon Creek is approximately 6,175 acres. The new development represents 0.15% of the entire basin. The increase in volume of runoff in the creek is negligible and will not significantly affect the stream velocities. In addition, the development will control the runoff to the creek. The new outlet facilities are designed to avoid flow through areas that are subject to erosion and will reduce velocity as compared to the existing condition. The potential for siltation and erosion in the creek, as well as the discharge of pollutants to the creek will be decreased as a result of the improvements.

CEQA Questions & Answers

Would the project:

1. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on- or off-site?

No. The Harbison Canyon Creek flows through the remainder parcel of the project. The entire flood plain limits are contained within the remainder parcel. No improvements are planned within the remainder parcel with the exception of a new bio-swale that directs runoff away from an existing horse riding rink. The flow pattern within the drainage basin to the east will be maintained. Treatment and Source Control BMP's are proposed in the design to reduce the possibility of any erosion or siltation after a storm event, both on- and off-site.

2. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on- or off-site?

No. The site has been designed with Source Control and Treatment BMP's that will minimize any increase in the peak rate of runoff. There will be an increase in the volume of runoff due to the increase in impervious pavement, but the increase is negligible when compared to the lot sizes and will not result in any on- or off-site flooding.

3. Create or contribute runoff water that would exceed the capacity of existing or planned storm water drainage systems?

No. There is no existing storm drainage system and the proposed drainage system has been designed to withstand the 100-year flood.

4. Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps? For example: research the foregoing and provide same (to indicate applicability or not) in the study.

No. The proposed building pads are well outside of the flood zone.

5. Place within a 100-year flood hazard area structures that would impede or redirect flood flows?

   No new structures will be constructed within the 100-year flood plain.

6. Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam on-site or off-site?

No dams or levees exist upstream of any watercourses on this project.

Works Cited

Brater and King. Handbook of Hydraulics, Sixth Edition. Pages 6-14 - 6-16.

McGraw-Hill, Inc. 1976.

County of San Diego. Drainage Design Manual.

APPENDIX

HYDROLOGY CALCULATIONS

DAVID EVANS AND ASSOCIATES INC.

RUNOFF COEFFICIENT CALCULATIONS				
	CARNEVALE SUBDIVISION		Date:	6/2/10
Assumption:			W.O. #	12594.00
Runoff coefficient "C" based on the County of San Diego Hydrology Manual, Table 3-1, for Soil Type B			Calc'd by:	NY
			Checked by:	PM

Basin Designation	Development Type	Run off Coefficient "C"	% of Basin Area	Adjusted "C"	Total Basin Area (Acres)	Area of Development Type (Acres)	Basin Total Area Check
EXISTING CONDITIONS							
A	Undisturbed Natural Terrain	0.25	100%	0.25	17.7	17.7	100%
				0.25			
PROPOSED CONDITIONS (Assume 1.0 acre developed per lot)							
A	Undisturbed Natural Terrain	0.25	77%	0.19	17.7	13.7	77%
	Residential, 1DU/A or less	0.32	23%	0.07	17.7	4	23%
				0.27			100%

RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use	% IMPER.	Runoff Coefficient "C"			
		Soil Type			
		A	B	C	D
Permanent Open Space (Natural)	0*	0.20	0.25	0.30	0.35
Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Residential, 7.3 SU/A or less	40	0.48	0.51	0.54	0.57
Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Neighborhood Commercial	80	0.76	0.77	0.78	0.79
General Commercial	85	0.80	0.80	0.81	0.82
Office Professional/ Comercial	90	0.83	0.84	0.84	0.85
Limited Industrial	90	0.83	0.84	0.84	0.85
General Industrial	95	0.87	0.87	0.87	0.87

PAGE NO:	
DATE (THIS SHEET):	6/2/10
W.O. #:	12594.00
CALC'D BY:	NY
CHECKED BY:	PM
BASIN MAP TITLE:	
BASIN MAP DATE:	

PROJECT TITLE: Carnivale Subdivision / County of San Diego - TM 21133

LINTVEDT, McCOLL, & ASSOCIATES

TIME OF CONCENTRATION CALCULATIONS - NO ROUTING

BASIN		OVERLAND FLOW - NATURAL WATERSHEDS			GRADED/COBBLE LINED/CONCRETE DITCH FLOW (SEE BELOW FOR N VALUE)					STORM DRIAN PIPE						Time of Conc
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
TRIBUTARY AREA (ACRE)	C RUNOFF COEF.	HEIGHT OF AVG. SLOPE LINE (FT)	LENGTH (FT)	Tc (MIN)	AVG. SLOPE (%)	N ROUGH-NESS	LENGTH (FT)	VELOC. (FT/SEC)	Tc (MIN)	S(pipe) AVG. Pipe Slope (%)	N ROUGH-NESS	L LENGTH (FEET)	D PIPE DIAMET-ER (IN)	V(Pipe) VELOC. (FT/SEC)	Tc TIME (MIN)	Tc (MIN)
EXISTING CONDITIONS																
BASIN A																
17.7	0.25	215.0	775.0	2.1										0.0	0.0	2.1
		60.0	640.0	2.8										0.0	0.0	2.8
					8.3%	0.025	120.0	10.5	0.2					0.0	0.0	0.2
					18.5%	0.025	162.0	14.2	0.2					0.0	0.0	0.2
					8.0%	0.025	375.0	10.4	0.6					0.0	0.0	0.6
																5.9
PROPOSED CONDITIONS																
BASIN A																
17.7	0.27	232.0	970.0	2.7												2.7
					5.6%	0.013	180.0	15.1	0.2							0.2
		25.0	220.0	1.1												1.1
										5.0%	0.013	20.0	18.0	1.5	0.22	0.2
					13.3%	0.035	390.0	10.0	0.7							0.7
										5.0%	0.013	30.0	30.0	2.1	0.24	0.2
					6.5%	0.035	245.0	7.6	0.5							0.5
										3.0%	0.013	33.0	30.0	1.3	0.44	0.4
					0.5%	0.035	85.0	2.9	0.5							0.5
																6.6

AUTOMATIC CALCULATIONS IN THIS TABLE ARE BASED ON THE COUNTY OF SAN DIEGO'S *HYDROLOGY MANUAL* , JUNE 2003 EDITION, AND THE FOLLOWING:

Column 5: Time of Concentration (Tc) for Overland flow - Natural is based on the formula in the *Hydrology Manual,* Figure 3-4: $Tc = ((11.9L^3)/H)^{.385,}$ where H is not the max. elevation difference, but the elevation of the effective slope line.

Column 9: Ditch Velocity is estimated as $V = (3.5NCA)^{(1/4)}S^{(3/8)}(0.85/N)$ (which is based on Mannings Formula, the Rational Formula over sub-basin, a circular pipe half full, and intensity I of 3.5 inches/hour), and no spilling.

Column 10: Ditch flow Time of Concentration Tc = Length of Travel / Velocity.

Column 15: Pipe Velocity is estimated as $V = (1.49/N)*(D/4)^{(2/3)}S^{(1/2)}$ (which is based on Mannings Formula, the Rational Formula over sub-basin, a circular pipe half full).

Column 16: Pipe flow Time of Concentration Tc = Length of Travel / Velocity.

Column 17: Surface flow Time of Concentration Tc, is the sum of all concentration times (overland, ditch and pipe) along the longest path.

MANNINGS "N" COEFFICIENTS USED:

Graded Ditch = 0.025
Concrete Ditch = 0.013
Cobbled-Lined Ditch = 0.035
RCP Pipe = 0.013

Carnevale Subdivision TM 21133

EXISTING RUNOFF CALCULATIONS

BASIN A	
AREA	17.7
RUNOFF COEF.	0.25
Tc	5.9

DESIGN YEAR	P 6 HR STORM	INTENSITY	BASIN Q
Q100	2.9	6.8	30.2
Q10	1.9	4.5	19.8
Q5	1.7	4.0	17.7
Q2	1.3	3.1	13.6
20% of Q5			3.5

PROPOSED RUNOFF CALCULATIONS

BASIN A	
AREA	17.7
RUNOFF COEF.	0.27
Tc	6.6

DESIGN YEAR	P 6 HR STORM	INTENSITY	BASIN Q
Q100	2.9	6.4	30.0
Q10	1.9	4.2	19.7
Q5	1.7	3.7	17.6
Q2	1.3	2.9	13.4
20% of Q5			3.5

DATE:	06/02/10
W.O. #:	12594
CALC'D BY:	NY
CHECKED BY:	PM

Pipe Sizing Calculations - No Routing

PROJECT TITLE: CARNIVALE SUBDIVISION

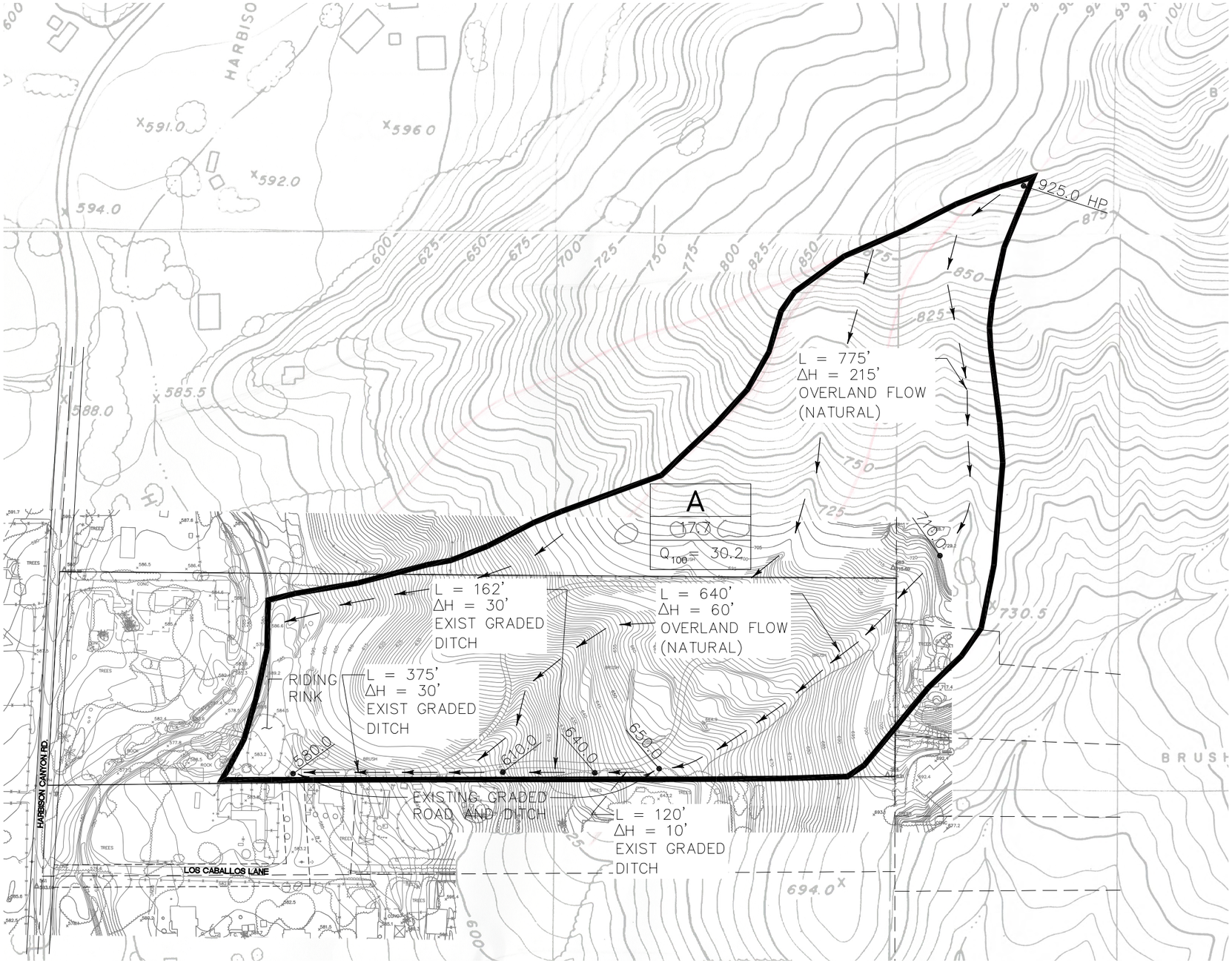
PIPE NAME	AREA (ACRE)	RUNOFF COEF.	Tc	P 6 hour 100 Year Storm	100yr INTENSITY	BASIN Q (cfs)	PIPE DIA. (IN) See below for sizing chart
1	2	3	4	5	6	8	9
PROPOSED CONDITIONS - BASIN A							
P-1	4.5	0.29	5.0	2.9	7.6	10.0	18
P-2	6.7	0.29	5.0	2.9	7.6	14.8	30
P-3	1.0	0.29	5.0	2.9	7.6	2.2	30
Total Area	12.2					27.1	

Calculations in this table are based on the Rational Method with the following formulas:

2 Tributory flow area (Acres)
3 Runoff Coefficient - see runoff coefficient calculations - Appendix D
4 Time of Concentration - see runnoff coeffieient table - Appendix D
5 P 6 Hour storm is taken from the County of San Diego Drainage Manual Isopluvial Maps for the Design Storm. See copy in Appendix G
6 Intensity (I) is based on the formual in the County of San Diego Hydrology Manual, page 3-7, $I = 7.44 (P6) D^{-.645}$ where D is the rainfall duration (equal to Tc for maximum intensity)
8 Q = CIA=Runoff Coefficient * Intensity * Area - Rational formula per county of San Diego Hydrology Manual,
9 Q=A*V

Pipe Size (Inches)	Area	Q Full (cfs)	V Full (fps)
6	0.20	1.37	7.0
8	0.35	2.44	7.0
10	0.55	3.82	7.0
12	0.79	5.50	7.0
15	1.23	8.59	7.0
18	1.77	12.37	7.0
24	3.14	21.99	7.0
30	4.91	34.36	7.0

HYDROLOGY MAPS



LEGEND:

A	BASIN DESIGNATOR
1.3	AREA (ACRES)
Q_{100}=X.X	RUNOFF VOLUME (CFS)
	DRAINAGE BASIN
	DIRECTION OF FLOW

1 FT CONTOUR INTERVALS

200 0 200 600

SCALE: 1"=200'

EXISTING CONDITIONS HYDROLOGY MAP (100 YEAR EVENT)

DATE: 6-2-2010	W.O. KCNV 02	DRFT: SNYO	CHK'D BY: PMM

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110 West A Street Suite 1700
San Diego California 92101
Phone: 600.400.0600

LEGEND:

A
1.3
Q_{50}=X.X

BASIN DESIGNATOR
AREA (ACRES)
RUNOFF VOLUME (CFS)

DRAINAGE BASIN

DIRECTION OF FLOW

NOTE: SEE "PROPOSED CONDITIONS HYDROLOGY MAP – DETAIL" FOR 100-SCALE DETAIL OF DRAINAGE SYSTEM FEATURES.

A
17.7
Q_{100}= 30.0

L = 970'
ΔH = 232'
OVERLAND FLOW
(NATURAL)

925.0 HP

L = 85'
ΔH = 0.4'
COBBLE-LINED
DITCH

L = 30'
ΔH = 1.5'
PIPE FLOW
(P-2)

L = 220'
ΔH = 25'
OVERLAND FLOW
(NATURAL)

L = 180'
ΔH =10'
CONC. DITCH

L = 33'
ΔH = 1'
PIPE FLOW
(P-3)

L = 245'
ΔH = 16'
COBBLE-LINED
DITCH

L = 390'
ΔH = 52.8'
COBBLE-LINED
DITCH

L = 20'
ΔH = 1'
PIPE FLOW (P-1)

REMAINDER

HARBISON CANYON CREEK

HARBISON CANYON RD.

OB CABALLOS CANE

HARBISON

BRUSH

200 0 200 600

SCALE: 1"=200'

PROPOSED CONDITIONS HYDROLOGY MAP (100 YEAR EVENT)

DATE: 11-18-2010	W.O. KCNV 02	DRFT: SNYO	CHK'D BY: PMM

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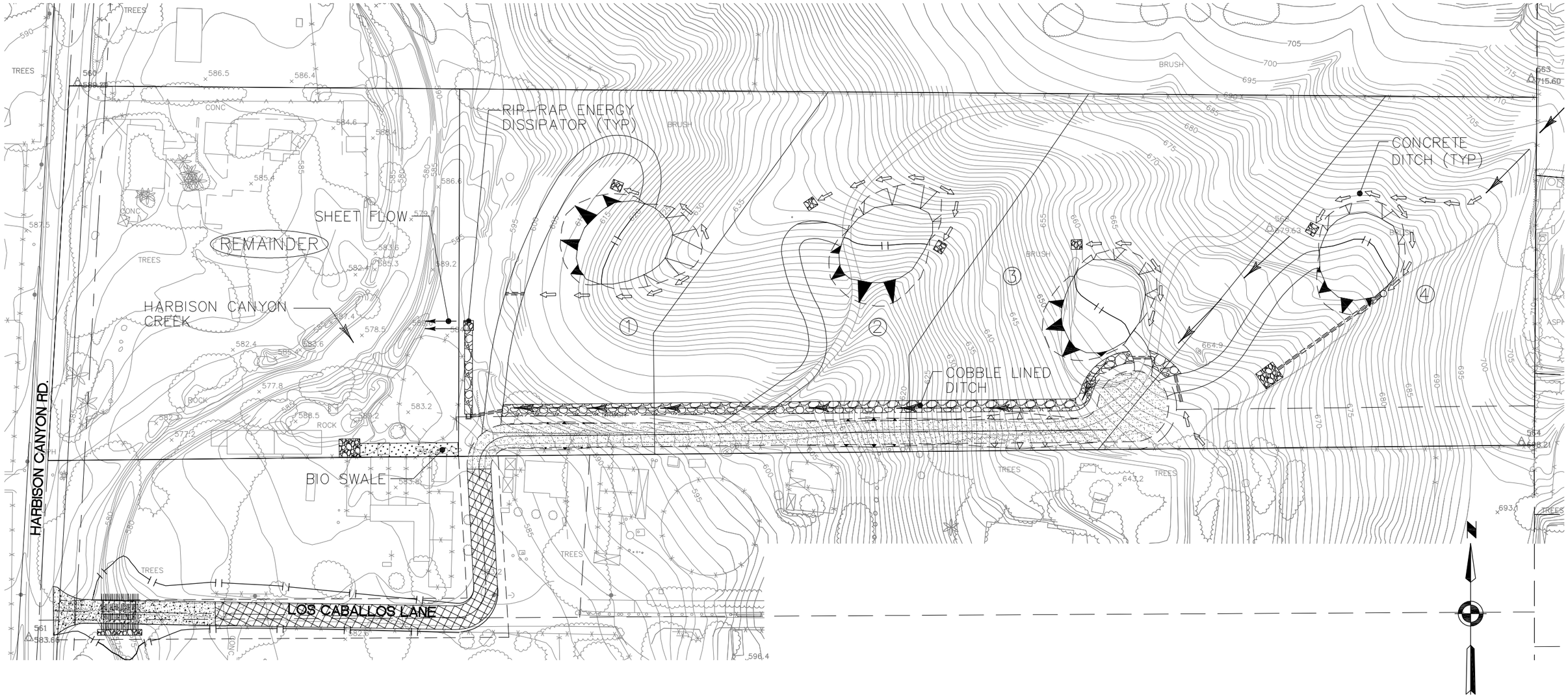
San Diego California 92101
Phone: 600.400.0600



PROPOSED CONDITIONS HYDROLOGY MAP - DETAIL (100 YEAR EVENT)

DATE:6-2-2010	W.O. KCNV 02	DRFT: SNYO	CHK'D BY: PMM

DAVID EVANS AND ASSOCIATES INC.
110 West A Street Suite 1700
San Diego California 92101
Phone: 600.400.0600

RUNOFF COEFFICIENTS TABLE

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

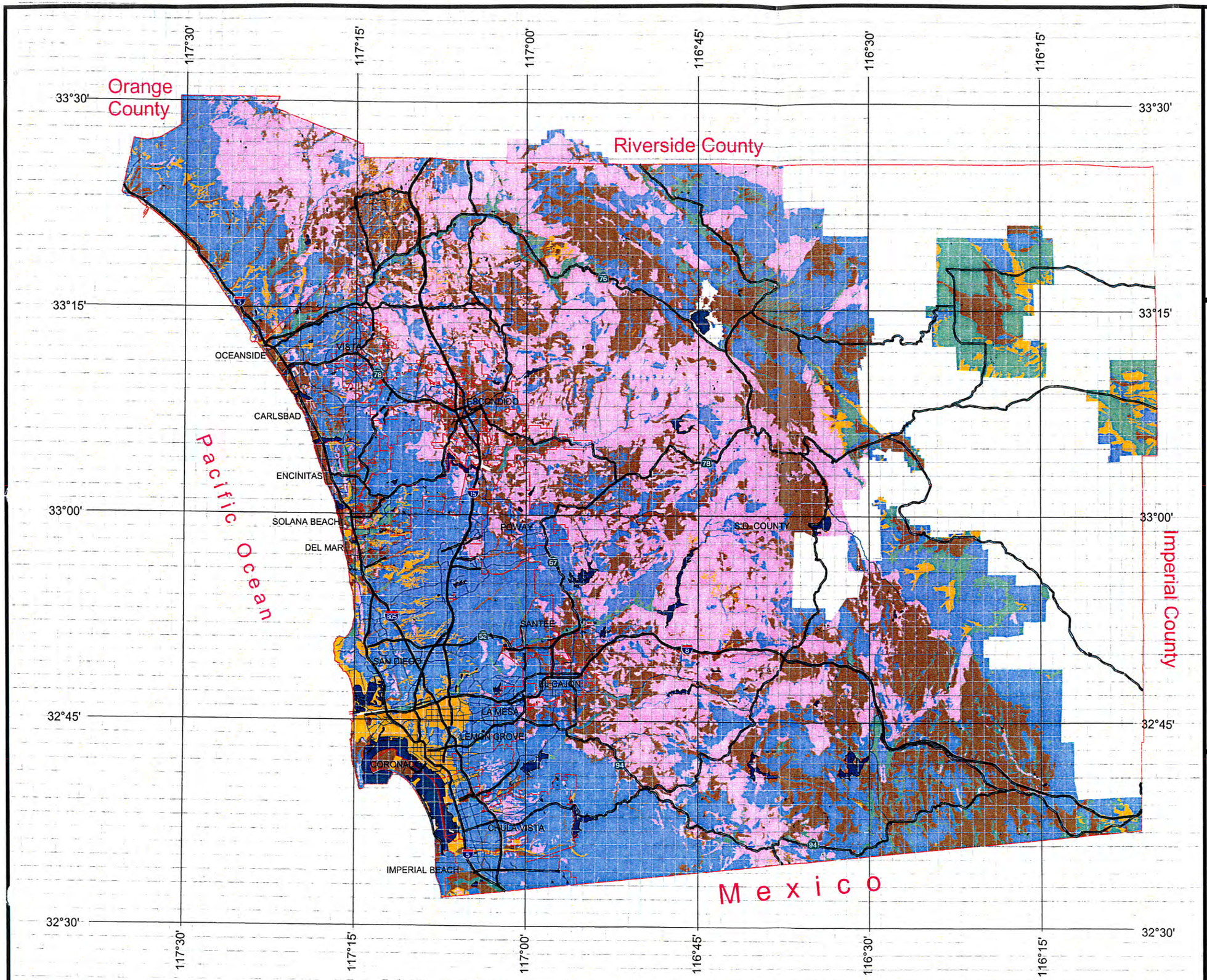
Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

SOIL MAP

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

DPW GIS
Department of Public Works
Geographic Information Services

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N
W E
S

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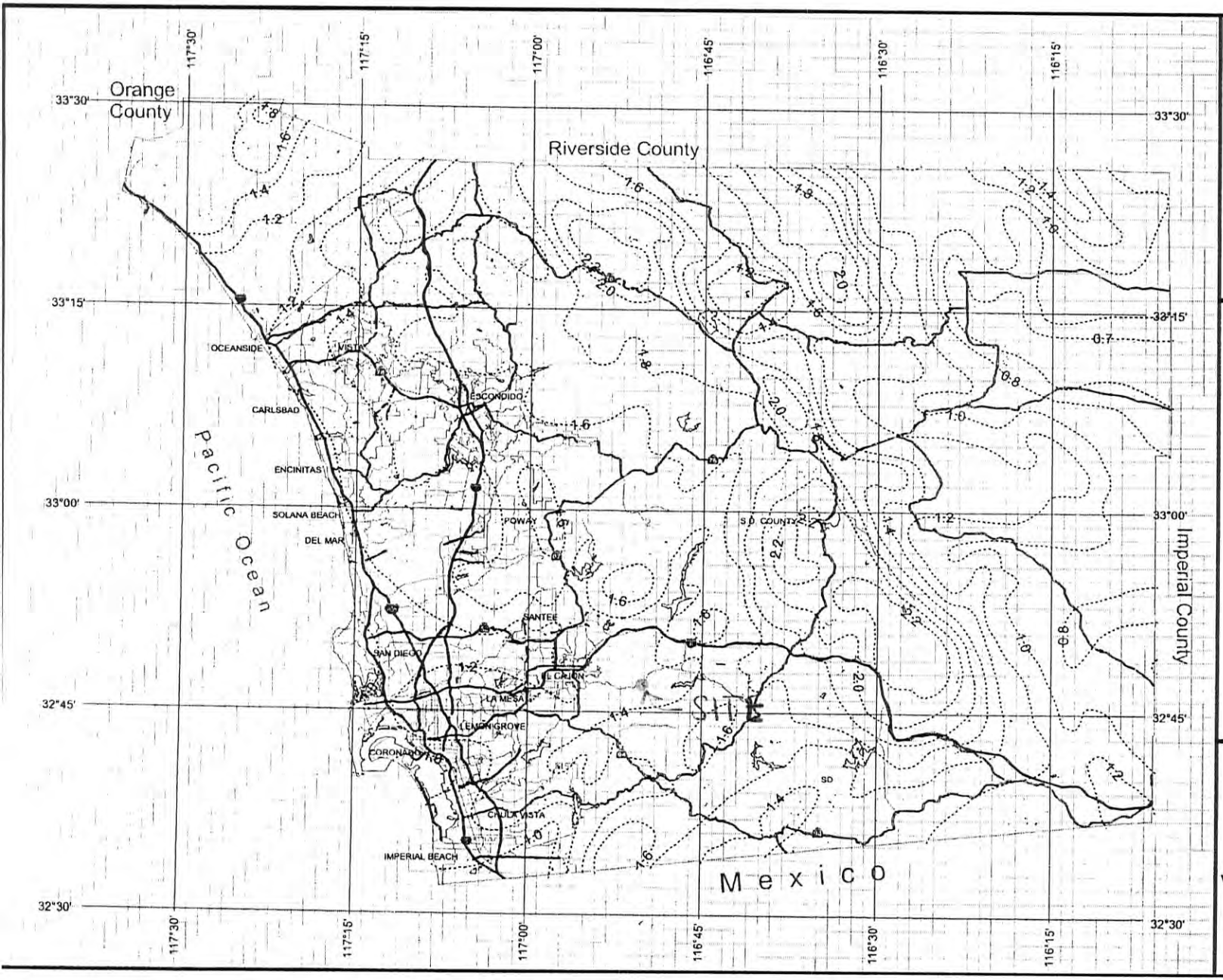
3 0 3 Miles

Rainfall Isopluvial Maps



County of San Diego Hydrology Manual

Rainfall Isopluvials

2 Year Rainfall Event - 6 Hours

Isopluvial (inches)

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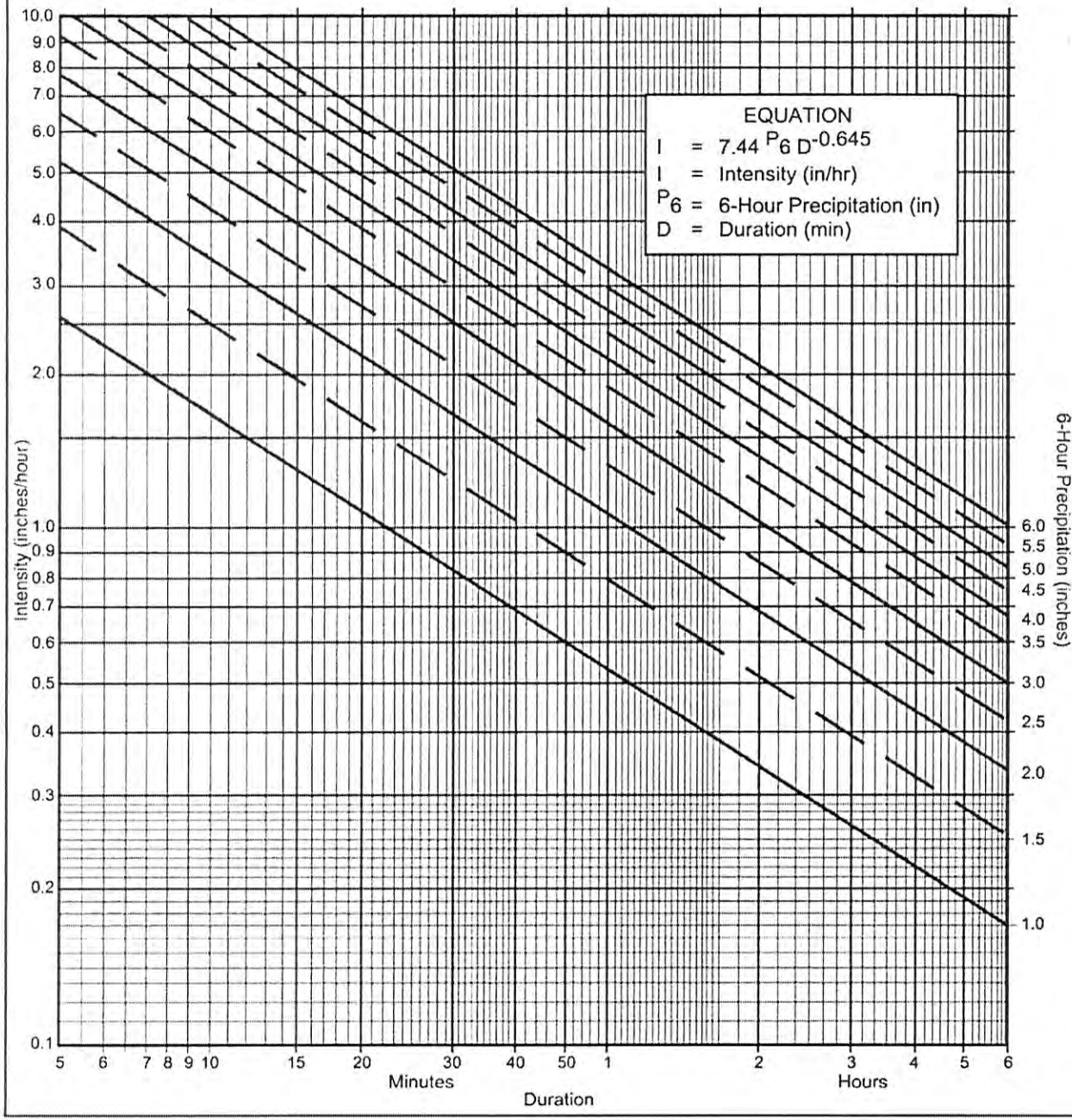
3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 2 year

(b) P_6 = 1.3 in., P_{24} = 2.0, $\frac{P_6}{P_{24}}$ = 65 %(2)

(c) Adjusted P_6(2) = _____ in.

(d) t_x = 5.9 min.

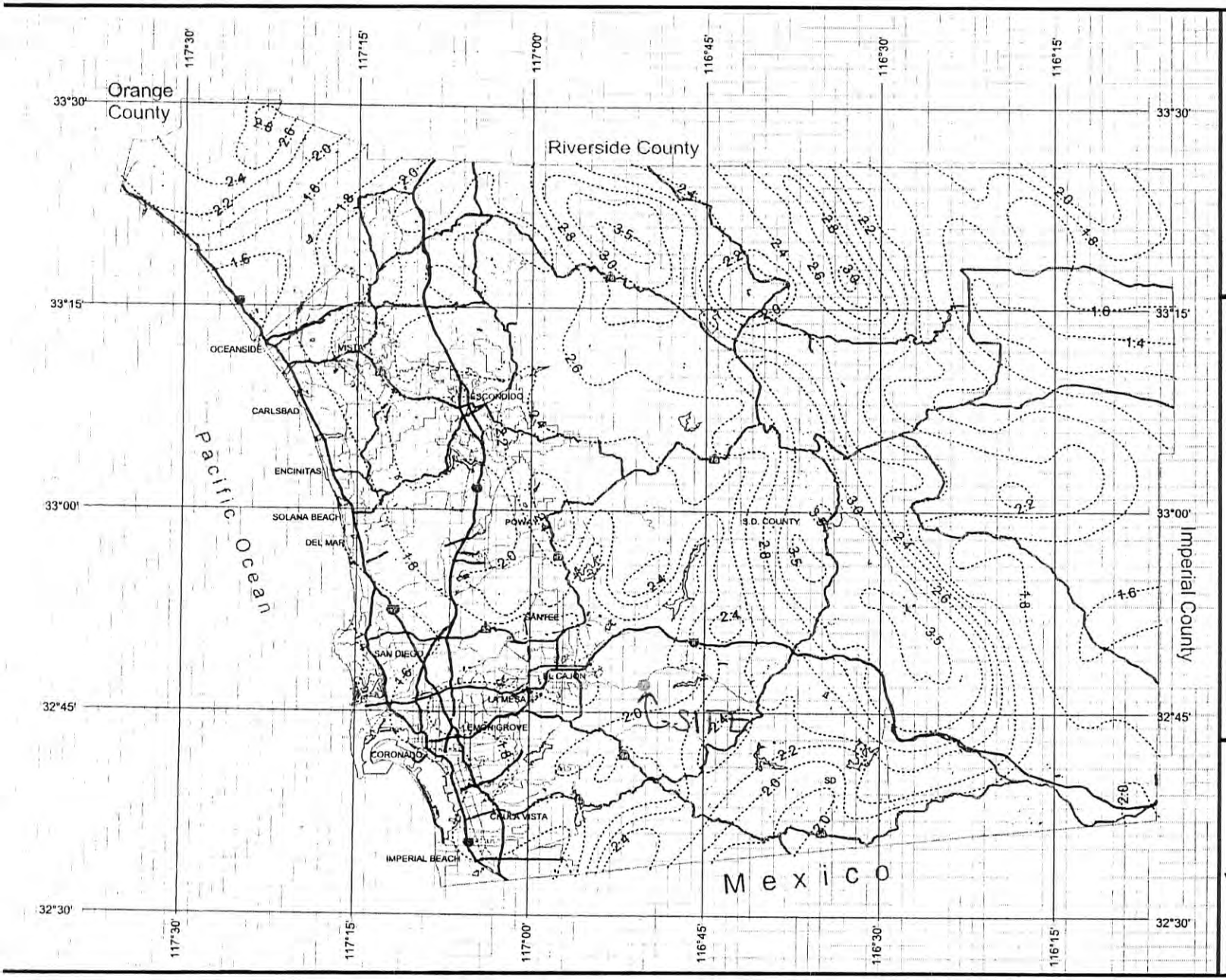
(e) I = 3.1 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 6 Hours

Isopluvial (inches)

DPW GIS

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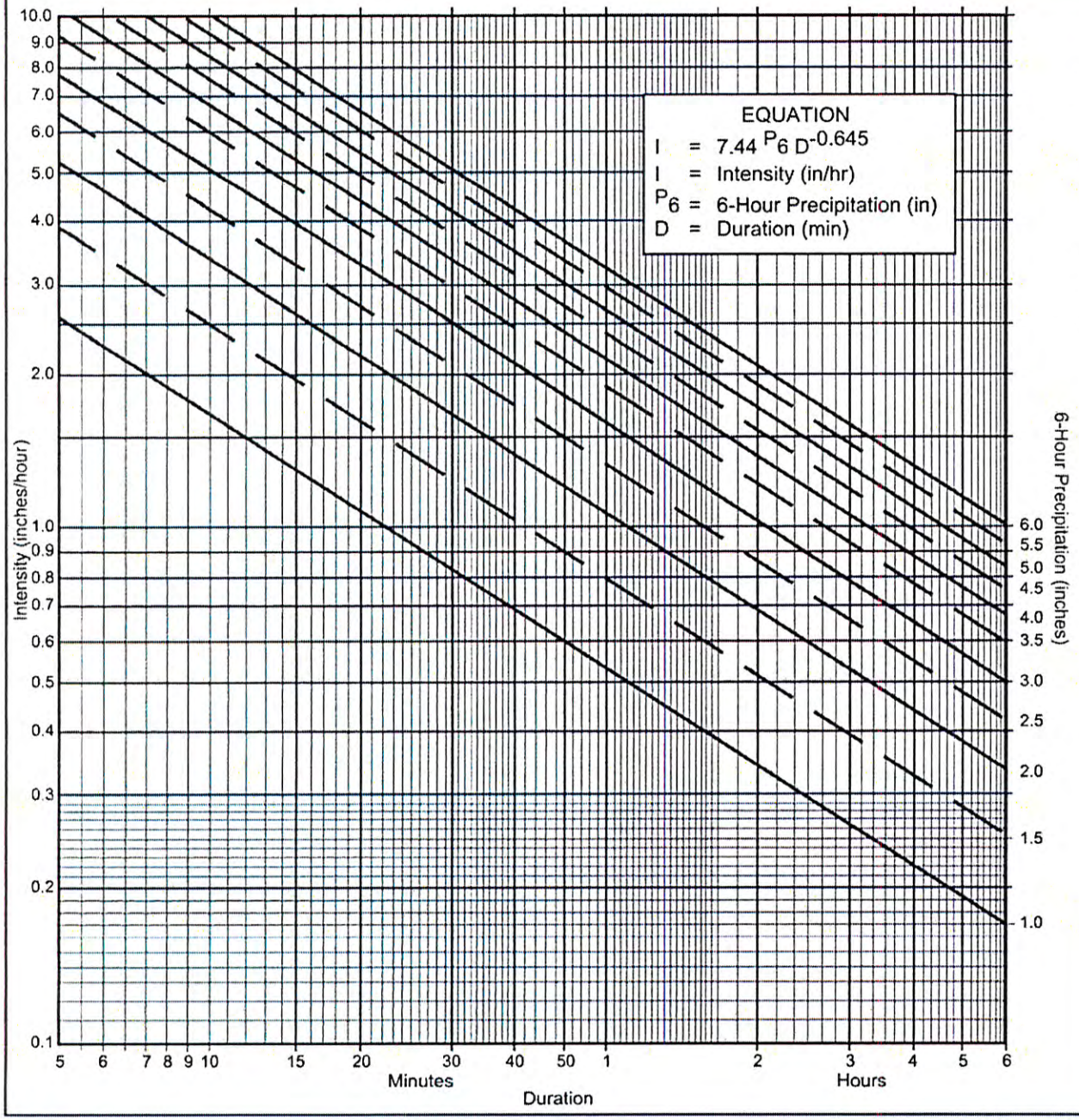
3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 10 year

(b) P_6 = 1.9 in., P_{24} = 4 $\frac{P_6}{P_{24}}$ = 48 %(2)

(c) Adjusted P_6(2) = _____ in.

(d) t_x = 5.9 min.

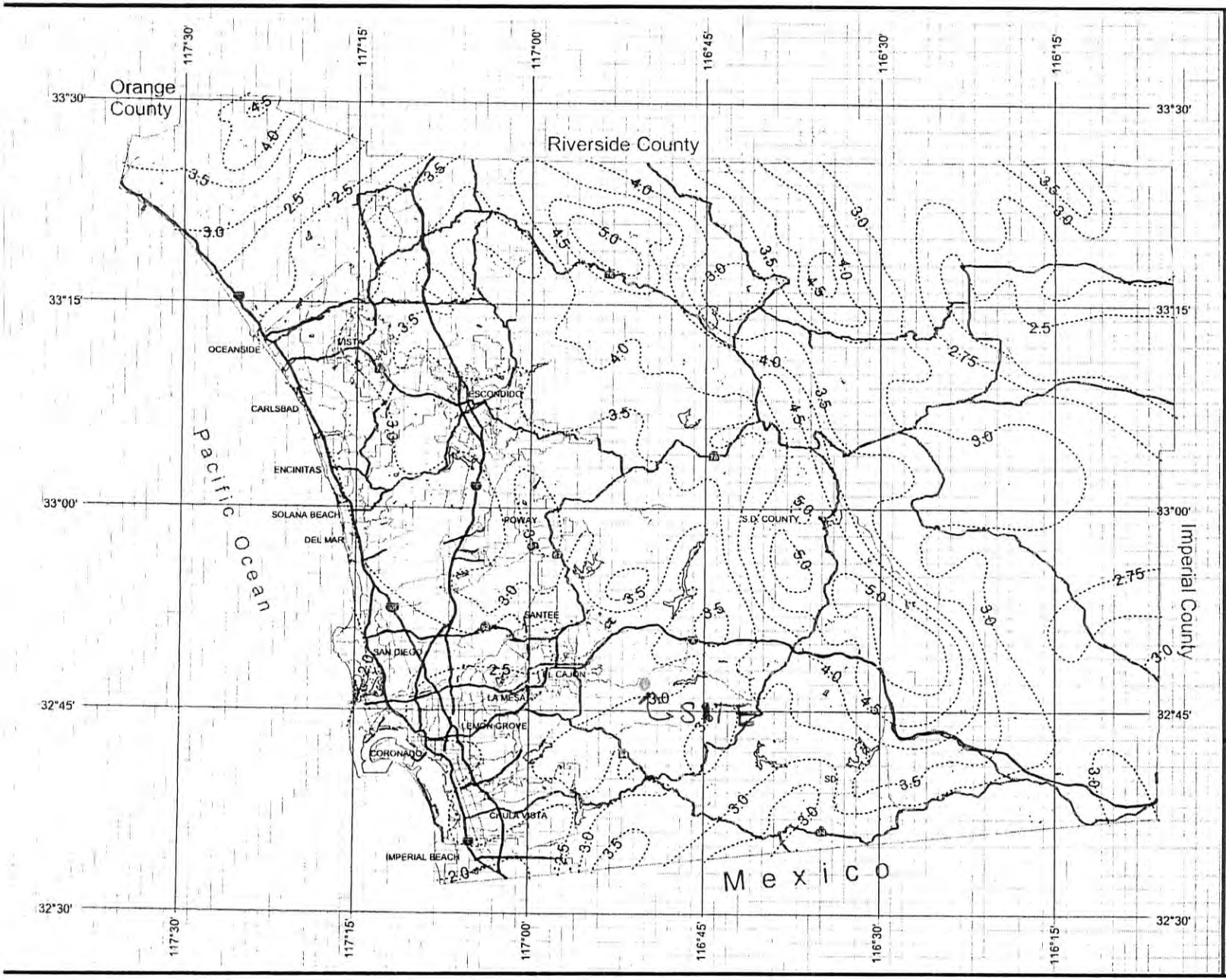
(e) I = 4.5 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

DPW GIS

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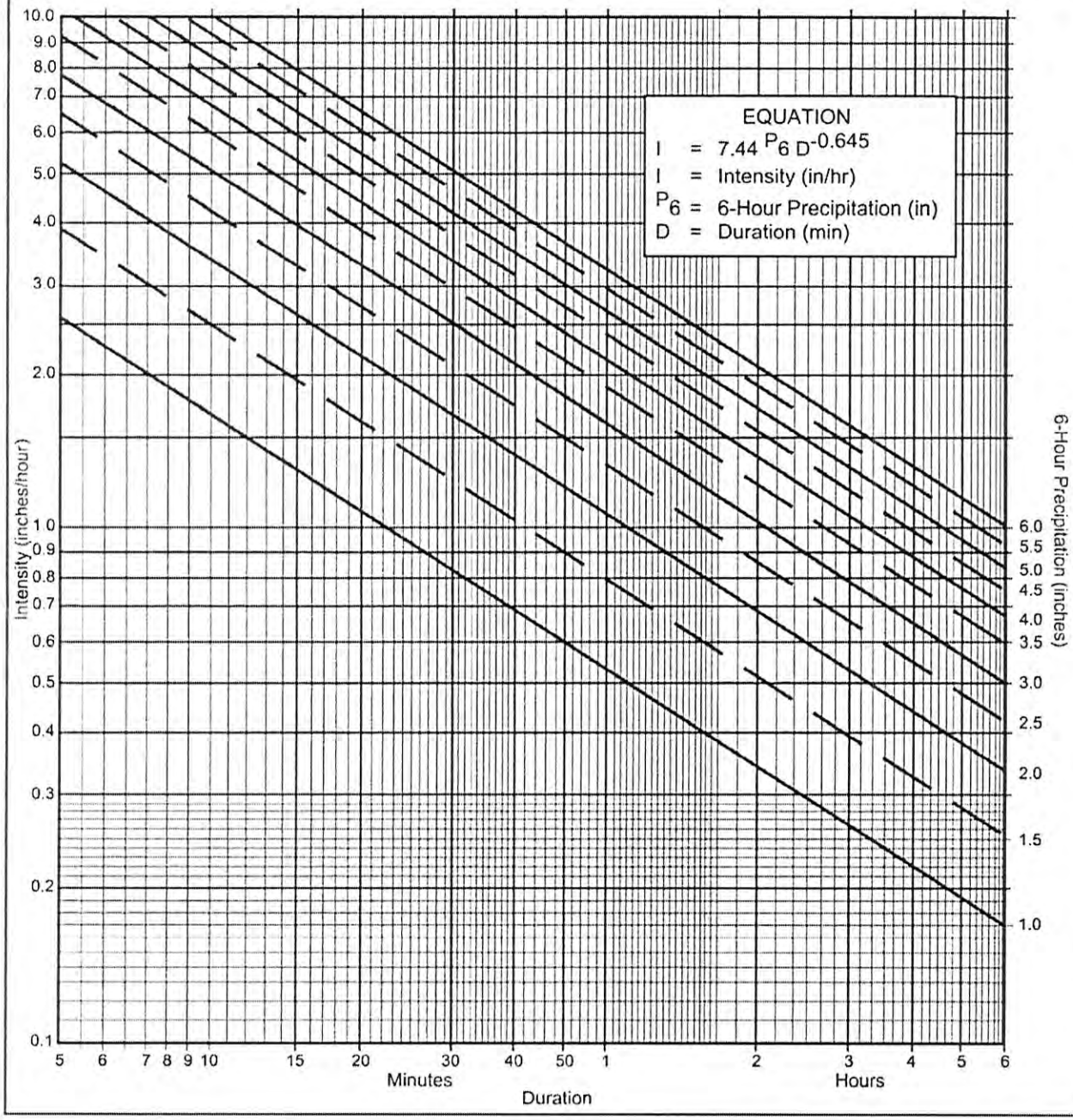
N W E S

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.9 in., P_{24} = 6 , $\frac{P_6}{P_{24}}$ = 48 %(2)

(c) Adjusted P_6(2) = _____ in.

(d) t_x = 5.9 min.

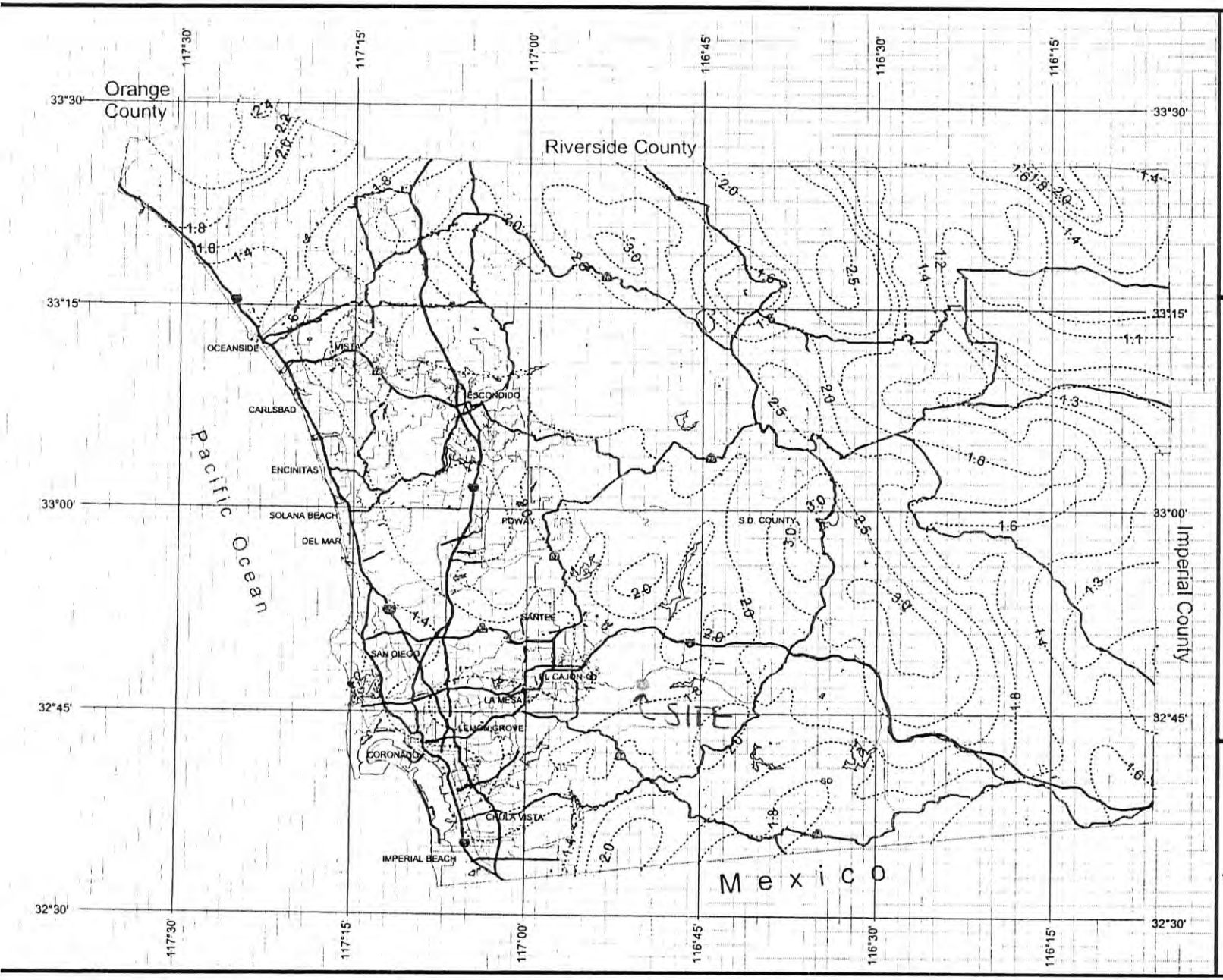
(e) I = 6.9 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

5 Year Rainfall Event - 6 Hours

Isopluvial (inches)

DPW GIS

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N W E S

3 0 3 Miles

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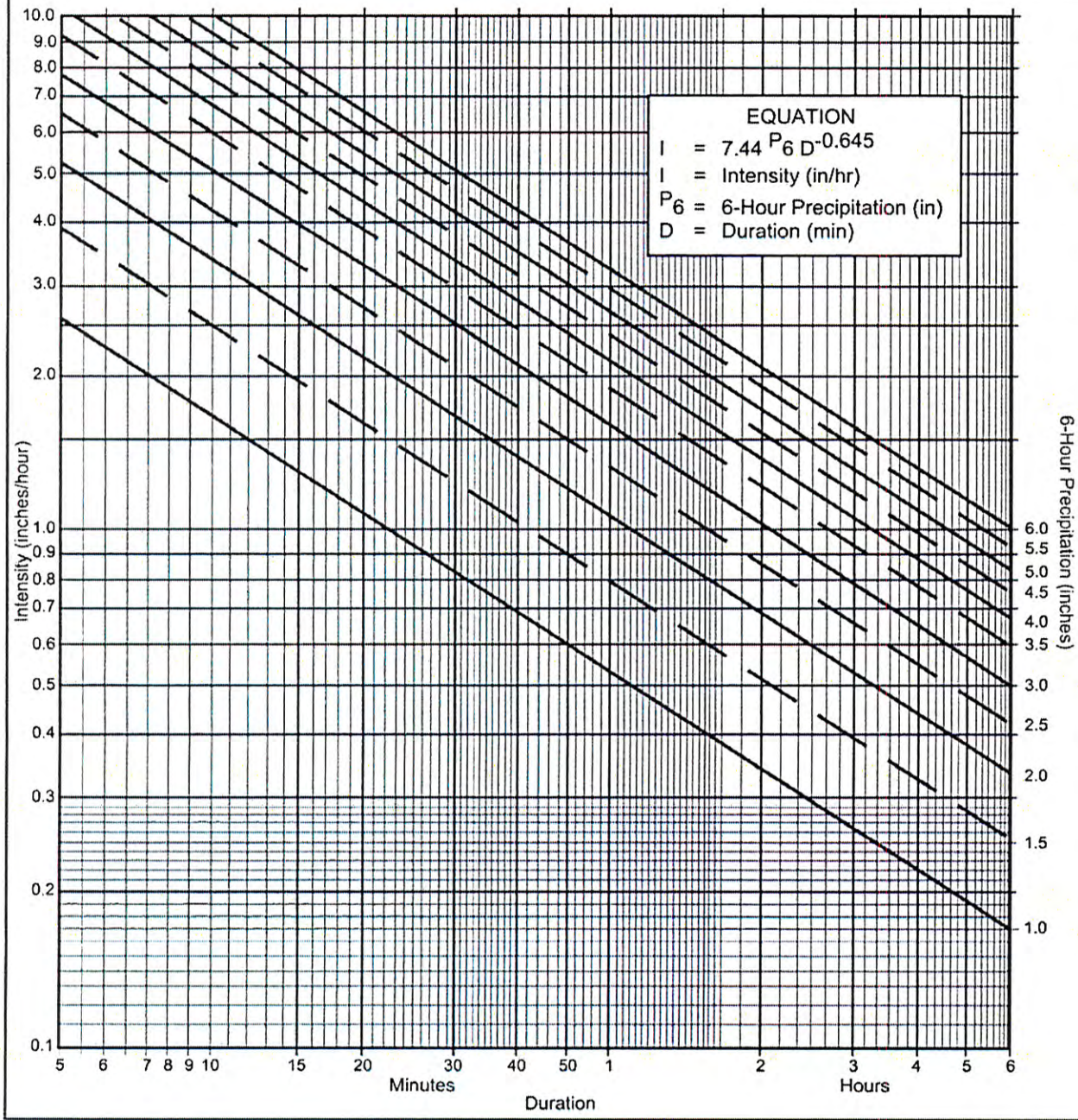

Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 5 year

(b) P_6 = 1.7 in., P_{24} = 3.0, $\frac{P_6}{P_{24}}$ = 57 %(2)

(c) Adjusted P_6(2) = _____ in.

(d) t_x = 5.9 min.

(e) I = 4.0 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1